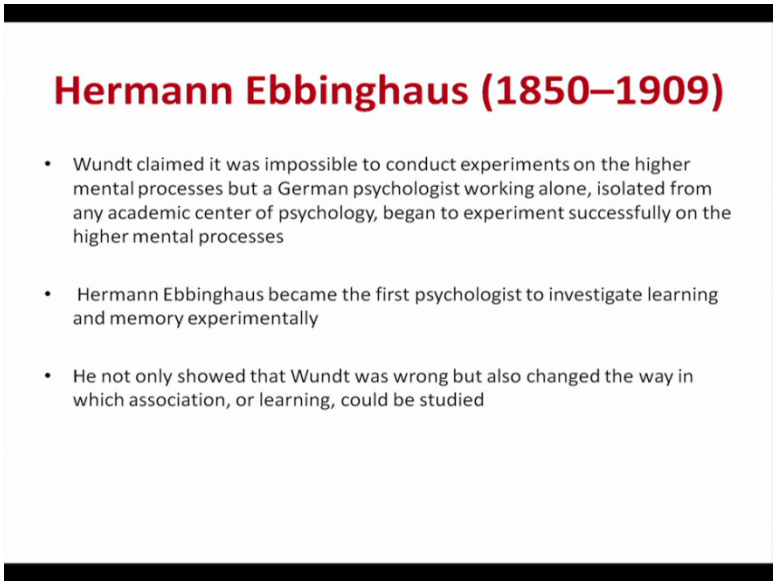
Professor Rajlakshmi Guha
Centre for Educational Technology
Indian Institute of Technology Kharagpur
Module 2
Lecture No 6
Herman Ebbinghaus on Memory

Hello and welcome to the second week of lectures in Great experiments in psychology. In this week we are going to cover the different experiments in studies that have been done under the purview of cognitive and social psychology. Cognitive and social psychology is a very interesting area which came to develop in the last century primarily. It started quite a while ago, but as psychology developed into an experimental science, but with time especially in the last century cognitive psychology got more prominence.

Social psychology also became important with the importance of given to several various cultures and especially their influences on social behaviour its influences on the individuals psychological makeup. Today's lecture so between the lectures of 6 and 10 we are going to cover some of the topics and some of the great studies in cognitive and social psychology, but in today's lecture we will go back a little and we will discuss one of the masters of psychology primarily who started who revolutionize experimentation and who showed that in psychology you can carry on with experimentation on and one single individual and you can do it scientifically and with your research findings being recorded over the centuries and still it is used today.

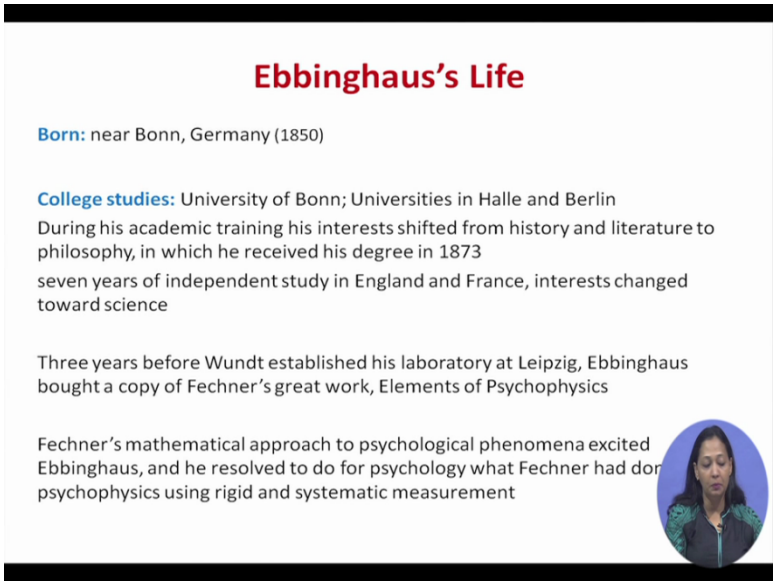
(Refer Slide Time: 2:39)



Now such an individual is Herman Ebbinghaus. Herman Ebbinghaus lived between 1850 and 1909 and Ebbinghaus thus as you can understand he was there during Wilhelm Wundt's time. Now Wilhelm Wundt worked on consciousness and he was working on several ideas as to his on action especially on sensation, feeling and he gave his voluntarisms theory which was later taken up by Titchener, Kulpe and several others. Bbut on the same time during the same time another individual that is Herman Ebbinghaus started working by himself individually and his work is on memory it is still one of the major experimentation done and that too during it was carried out imagine during way back in the 19th century. Now Wundt claimed that it was impossible to conduct experiments on the higher mental processes, but Ebbinghaus he was also a German psychologists and he was working alone and began to experiment successfully on the higher mental processes.

Ebbinghaus work isolated away from any academic environment, he worked alone in his home at his home and he started he became influenced by Fechner and he wanted to investigate learning. Now, Wundt said that you cannot actually study learning and Ebbinghaus proved him wrong and he showed that learning and memory can be experimentally verified and it can be studied.

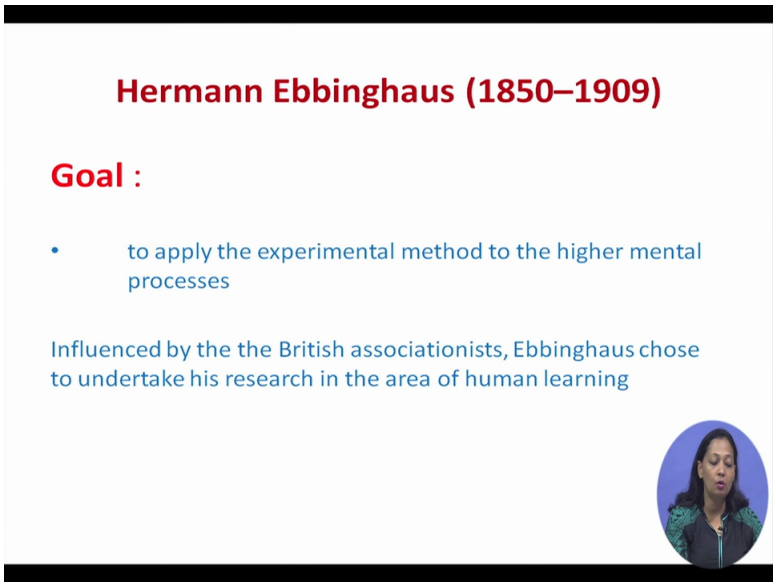
(Refer Slide Time: 3:40)



Ebbinghaus was born in Germany in 1850, he had studied finished his college studies in the university of Bonn and universities in Halle and Berlin and during his academic training his interest shifted from history and literature to philosophy in which he received his degree in 1873. Now if you see, Ebbinghaus was very different from his contemporary piers, so most of them were physiologists, physicists who were translating their ideas into psychology.

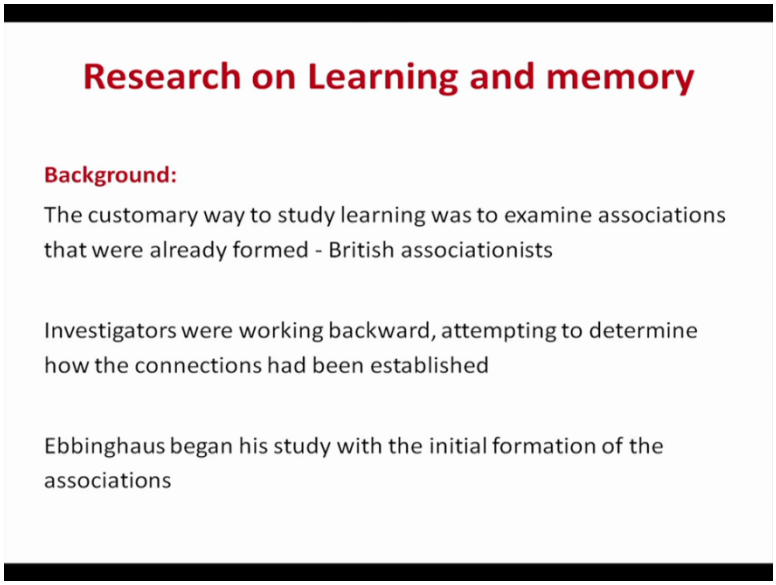
Ebbinghaus on the other hand had his academic background, he had pursued his academic in history and literature and he pursued 7 years in independent study in England and France and finally his interest changed more towards science. He also served the Prussian war after this and 3 years just before Wundt established his laboratory at Leipzig that is, Ebbinghaus bought a second hand copy of Fechners great work in one of the London book stores and that is The Elements of Psychophysics and this work of Fechner really influenced Ebbinghaus and he was really excited to see that the psychological phenomena could be studied and he resolved to do for psychology what Fechner had done for psychophysics.

(Refer Slide Time: 5:22)



So he started he planned to use strict and rigid systematic measurement to understand learning and memory. So his goal Herman Ebbinghauss goal was to apply the experimental methods to the higher mental processes, now what do you understand by higher mental processes. It could be now-a-days we can of course understand that higher mental processes would be involving a lot of processes that would primarily be related to cognition, but at that point in time the British associationists were already planning to take up the work on learning human learning and Ebbinghaus also chose to undertake his research on human learning and memory.

(Refer Slide Time: 6:07)

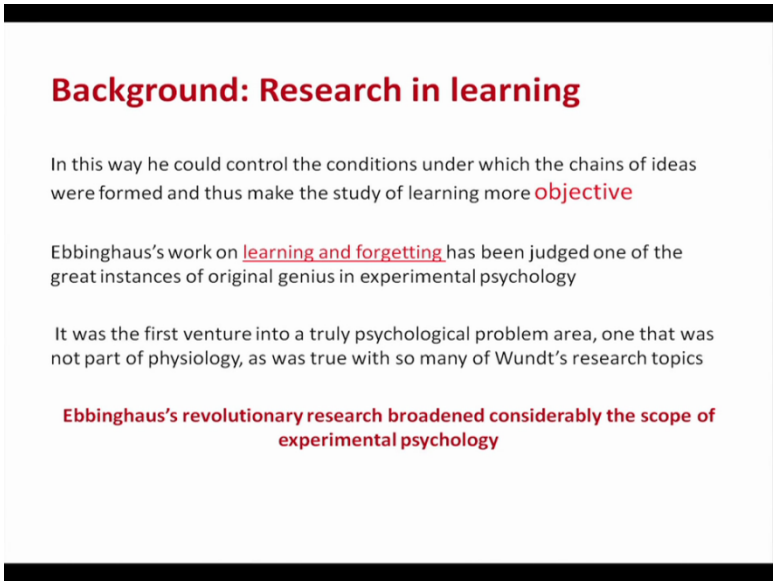


So what was the current status of research on learning and memory at that time. At that point in time the customary way to study learning was to examine the associations that were already formed and the British associationists as I mentioned were studying it in this way, so how do we form our associations, so that is what was being studied by the British associationists.

So according to Ebbinghaus, investigators were working backwards so they were attempting to determine how the connections had already being established , so when a learning has been done already people were trying to establish how this connection was formed. So now Ebbinghaus wanted to show or wanted to see for himself, how these connections were being formed by actually doing it through experimentation. And that is where his work was different from the other researchers of his time.

So Ebbinghaus began his study with the initial formation of associations so he was not doing a post-hoax study, but we now know as the post-hoax studies where it is primarily quasi experimental research as we call it . Where the individual is studying a phenomenon that has already happened now that is how the British associationists were trying to understand learning. Ebbinghaus started to study he wanted to explore how learning was being formed by actually creating the experimental condition for learning to happen.

(Refer Slide Time: 7:29)



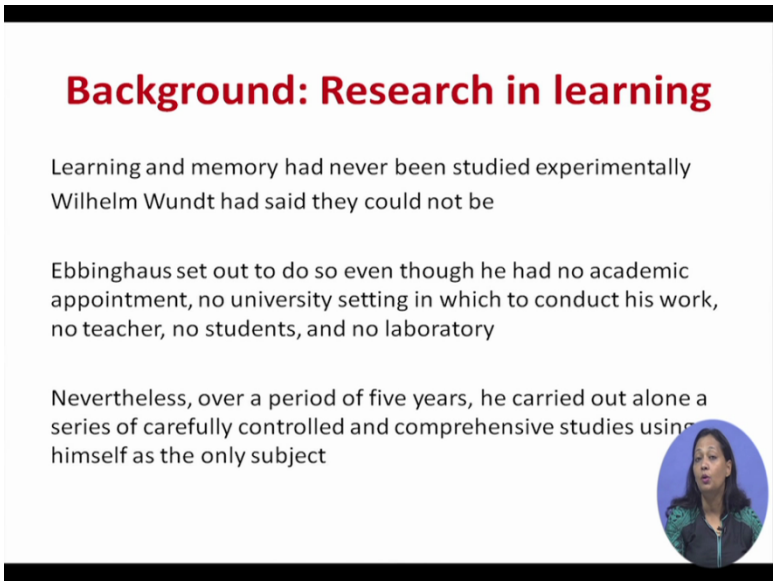
Now in this way he could control the conditions under which the chain of ideas were formed and thus make learning more objective, so see he is actually following the principles of scientific research where the independent variable can be manipulated and here the in this way he is trying to make the learning more objective. So earlier research was more of the British associationists research was primarily more of quasi experimental or post-hoax.

In this there the independent variable could not be manipulated. In this case to make it more objective he starting from scratch, so Ebbinghaus work on Learning and Forgetting has been judged as one of the great instances of original genius in experimental psychology. So in today's lecture though you know Ebbinghaus is though is just started the lecture by saying that cognitive and social psychology developed way later after a psychology had established itself as a science , there then too I am talking of Ebbinghaus as of one the major cognitive psychologists of his time and that is also in the 19 century. One of the reasons is that because Ebbinghaus had started his research on cognitive psychology at that at the time when nobody could even think about developing systematise research in this form and it is one of the greatest instances of original research in experimental psychology.

So, whenever we are talking of great studies in psychology no way can we mention can we forget about Herman Ebbinghaus. It was Herman Ebbinghaus's study was the first venture into a truly psychological problem area and it was not a part of physiology as was true of so many of Wundt and others other contemporary research topics. So basically one of the reasons perhaps being that most of them being physiologists of that time, they were trying to

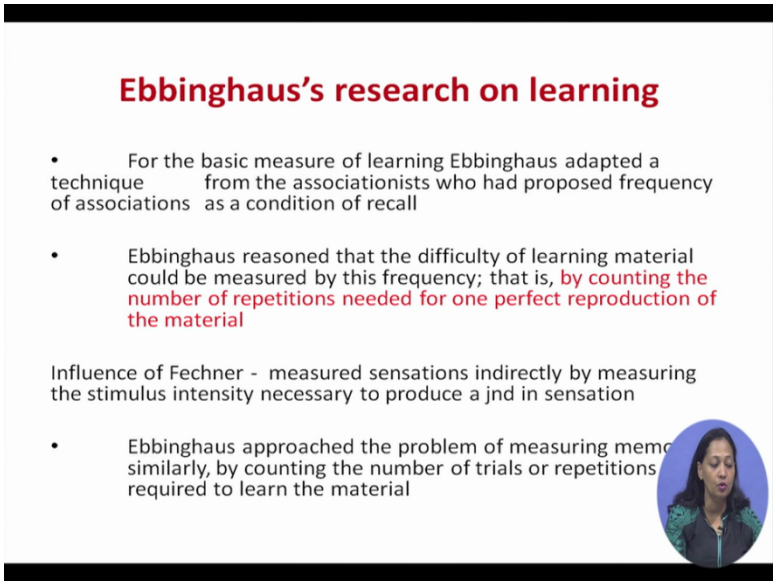
explore those areas that were already being undertaken by physiology. Herman Ebbinghaus since his back academic background was also a little different from his contemporaries dealt into something that was really contemporary as to it was a truly psychological problem area and it was very different from how the others were approaching the problem.

(Refer Slide Time: 10:31)



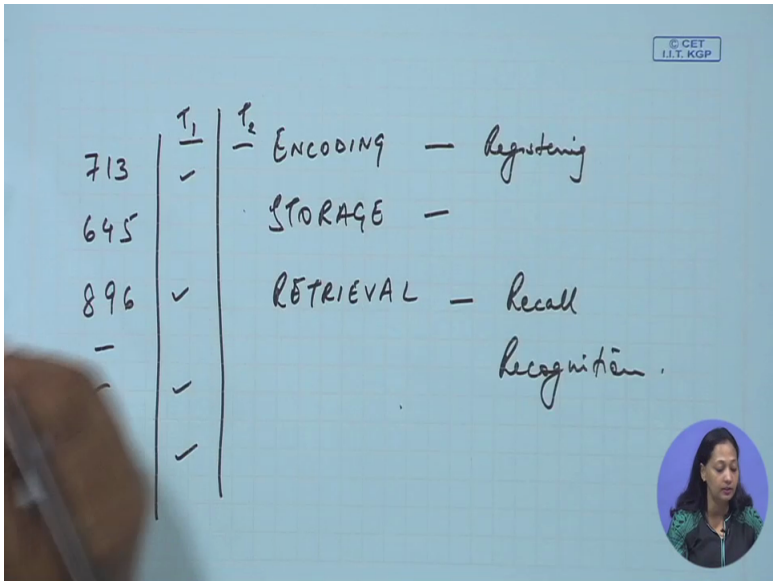
Ebbinghaus revolutionary research broadens considerably the scope of experimental psychology. So in one hand I am talking of experimental psychology on the other I am talking of cognitive psychology, mind you cognitive psychology explores learning and memory and it does it through experimentation and this work was began by Herman Ebbinghaus. So learning and memory had never been studied experimentally as Wilhelm Wundt had said they could not be. Ebbinghaus set out to do so even though he had no academic appointments, no university setting in which to conduct his work or no students or no teachers or no laboratory to assist him. Nevertheless over a period of 5 years he carried out his research alone in a series of carefully controlled and comprehensive studies using only himself as the subject.

(Refer Slide Time: 11:26)



So he did not have a group of students on whom he could explore or experiment on, he did not have a university backup nor a laboratory to continue his research, but he did all his experiments by himself as himself as the subject. So Ebbinghaus's research basic for the basic measure of learning he adapted a technique from the associationists who had proposed the frequencies of association as a condition of recall.

(Refer Slide Time: 12:31)



Now, whenever we are talking of memory there are one or two major principle that we must understand. So one is for earlier it was you know as memory studies developed over time and if many of you who are students of psychology, you know that primarily when we are talking of memory we are talking of 3 major processes one of them being Encoding, Storage and

Retrieval. So encoding is how you are registering the information, storage is as you can well understand how you are storing that information in your brain and retrieval would primarily involve two processes. One would be recall and the other would be recognition ok. So here Ebbinghaus adopted some of a technique from the associationists who had proposed that frequency of associations would be a condition of recall.

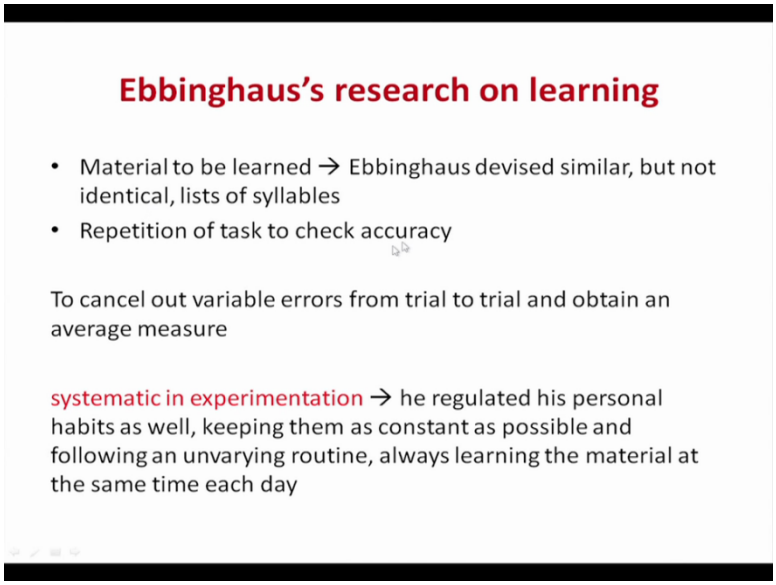
So how you recall a material so how you retrieve the material from your memory from your storage would actually depend on how many associations you have formed. So this is what the associationists were saying and Ebbinghaus adopted this technique and he reasoned that the difficulty of learning memory, a material could be measured by this frequency.

So you could understand by counting the number of repetitions needed for one perfect reproduction of the material. So how complex is the material you can understand by how many times it is required to learn that material. So say if there is one small rhyme say say something like Jack and Jill or one any other rhyme Humpty Dumpty say, so for these rhymes how much time is it taking for you to learn that material will actually give measure of how many repetition so how many times you have to repeat this to learn it and how much time has been taken will actually give you a measure of how complex a material is. Now, as you can see that this is also this was influenced by Fechner, so Fechner measured sensations indirectly by measuring the stimulus intensity necessary to produce a (())(14:17). So just for us to measure sensation Fechner studied the amount of stimulus that need to be increased to have a certain sensations.

We have discussed about this in the previous classes so Ebbinghaus was influenced by Fechner we have talked about this earlier and Ebbinghaus also tried to address the issue of memory in a similar manner. So he said that to understand how complex a material is or to understand to measure memory. You need to understand the number of trials or repetitions that is required to learn the material.

So say if put it like a you have you are learning 10 numbers, so it could be something like say one number has three digits, so it could be say like 713 645 896 say I have 10 such numbers so how long so this is trial one, so how many can you remember so perhaps you can only remember only 4. So how many trials are required for you to learn this material, so this is T1, it could be T2 so this whole material how long is it requiring to you to learn. So that will determine whether how complex this material is.

(Refer Slide Time: 15:55)



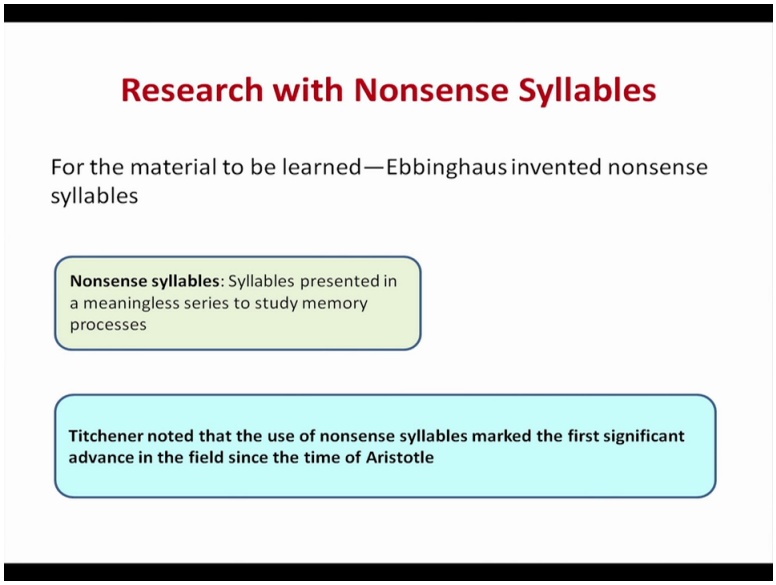
Now, he also said that the materials to be learned for the material to be learned Ebbinghaus's devised similar but not identical lists of syllables. We will talk about theses syllables very soon and he said that the repetition of the task was required to check the accuracy. So you learn it now after sometime you recall it again, so you see how much of it you can remember and to cancel out variable errors from trial to trial and obtain an average measure that was also very important. So Ebbinghaus was very systematic in his experimentation, just imagine at that time in the 19th century he regulated his personal habits as well keeping them as constant as possible and following an unvarying routine always learning the material at a particular time of the day same time of the day. Say, when we are conducting experiments today.

If you carrying out experiments on any psychological variable we say that one of the features that can actually affect the results is the time when you are conducting the experimentation, so you need to keep it in control, so as a control variable like if you are conducting some memory experiments some learning experiments say, at morning you are teaching a student something at morning any individual and then the next day's experiment if you do it at noon perhaps the results will vary. One of the major reasons being that the time of the day may also have an impact on the results, why? Now it could be that the students the individual or whom you are trying to conduct the experiment wakes up late, has a habit of getting up late, so he is fresher during the afternoon as compared or may be at during night as compared to the early hours of the mornings.

So if the results of the experiments show that the learning to learn 10 digits at morning took 20 trials and the next day the learning took in the afternoon took 7 trials so you could not interpret that it is because of the easy, the complexity of the material so the morning one was more complex as compared to the afternoon one. It could also be that the individual was more alert during the afternoon as compared to the morning. Just imagine we used these conditions right now these days when we are conducting experimentations we are also trying and control the time of the day the diurnal variation we keep that into account and way back Ebbinghaus, when he was conducting the experimentation on himself he was so systematic he tried to control it control the diurnal variation and its effects on memory.

So that is why he would conduct it at a particular time, each same time each day and he would generally follow an unvarying routine, so it is not that you know he was awake at night and that would have an impact on his performance in morning. So the next comes in the material with which he would conduct the learning now this is where Ebbinghaus is known for the use of nonsense syllables.

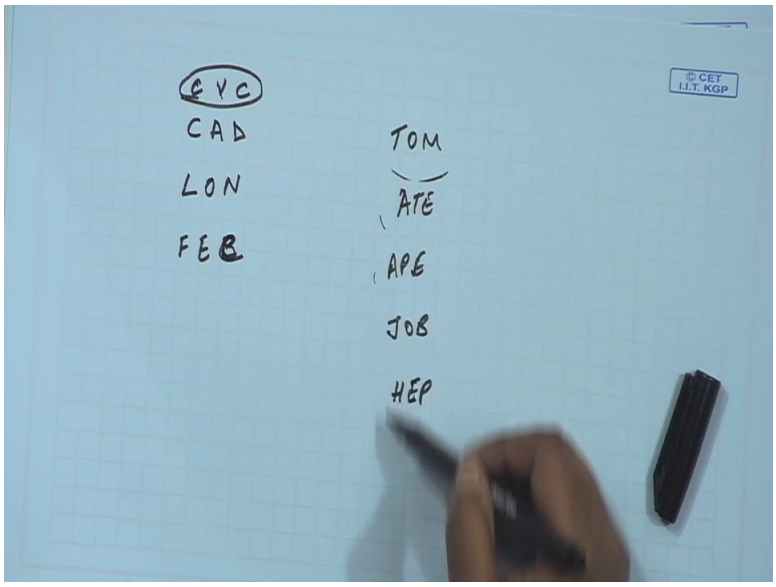
(Refer Slide Time: 19:36)



Nonsense syllables is an amazing thing that Ebbinghaus invented, so his idea was that if it is familiar material, this material may have associations for individual may not have association for another individual, so the learning is then dependent on what meaning the material has to the individual. On the other hand, if so we are not actually that is that is another variable that is confounding the results just like in the previous sessions as we mentioned, the time would be a factor that there would be a variable that would affect the results, so Ebbinghaus used nonsense syllables. Now what are nonsense syllables? Nonsense syllables are syllables

presented in a meaningless series to study the memory processes, so students who are actually psychology students who are trying to who are attending this course will be very familiar with the term nonsense syllables.

(Refer Slide Time: 20:54)



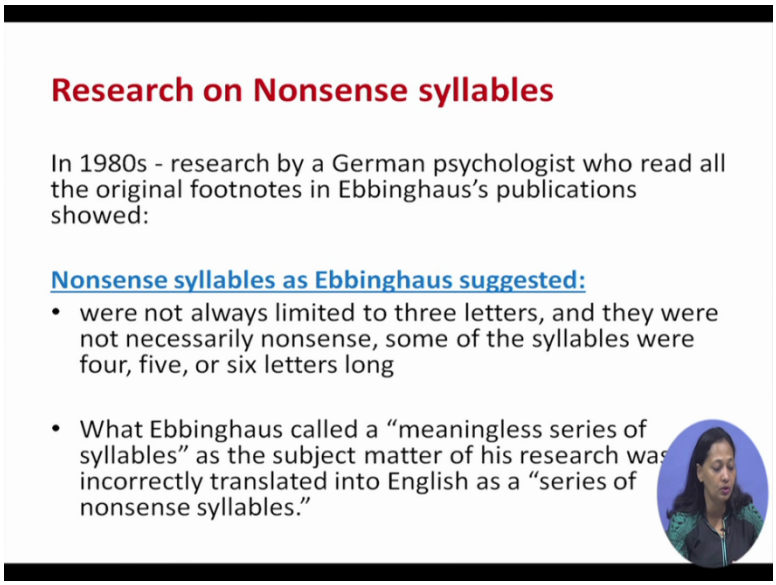
Some of few nonsense syllables that I will just try and write for you say CAD, LON now FEB may not be nonsense syllable FEC would be F E C ok. So now when I am so these are so this is a consonant vowel and another consonant, so that is how a nonsense syllable is made, mind you we will have to remember that Ebbinghaus conducted his experiments in German and these were translated later into English. So we these days conduct we make nonsense syllables like this and so basically it is a consonant a vowel and a consonant can be make it as three.

Ebbinghaus in his time did not make nonsense syllables of only 3 letters, they could be 4 even to the extent of 6 letters but they were meaningless they were series of words that were meaningless. The idea of using nonsense syllables is then these will not have associations. See, if I give give an individual to learn a list where there is TOM, ATE, APPLE ok APE, JOB HEP, so here since these are meaning full words I may form certain associations and remember them.

Now that would actually not be and say suppose there is another individual who is not familiar with the language or who do not have any associations with TOM or ATE or APE then he would not able to remember these words. So I am remembering this because of the associations that I can form. So now that would not give a proper measure, so Ebbinghaus

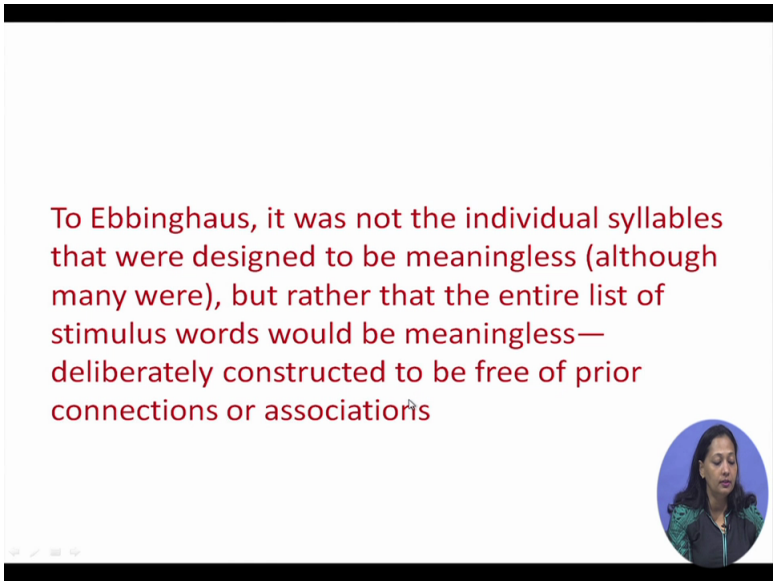
that is why to make this material neutral for everybody Ebbinghaus created nonsense syllables. Titchener noted that the use of the nonsense syllables marked the first significance advance in the field since the time of Aristotle, so Titchener gave him this accolade saying that this is the biggest invention of its time in psychology.

(Refer Slide Time: 23:31)



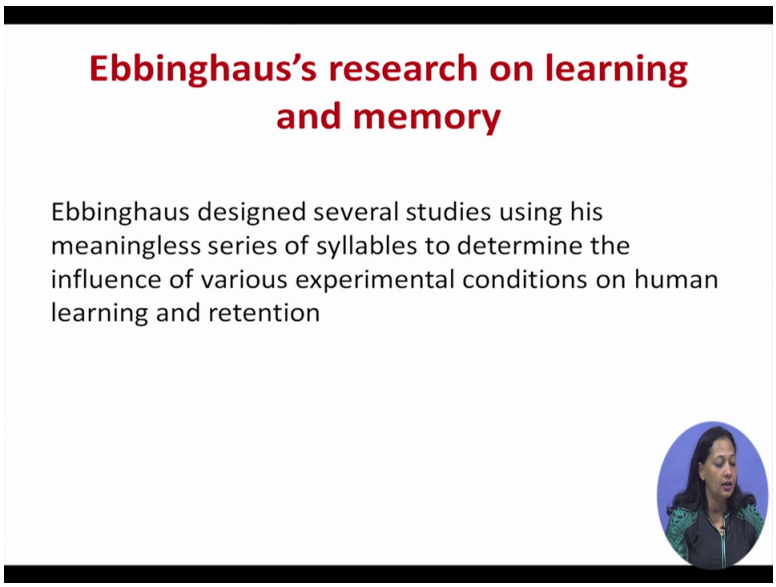
So in the 1980s actually you know as I was just mentioning research by a German psychologists to translate all of Ebbinghaus footnotes original footnotes in his publications showed that the nonsense syllables as Ebbinghaus suggested were not always limited to 3 letters they were not necessarily nonsense, some of the syllables were 4, 5 or 6 letters long. What Ebbinghaus actually meant was a meaningless series of syllables and the subject matter of his research was incorrectly translated in English as nonsense syllables. But nevertheless it does have nonsense syllables are meaningless and that is how we try and construct them today as in our laboratory research and it has really revolutionize the memory research.

(Refer Slide Time: 24:24)



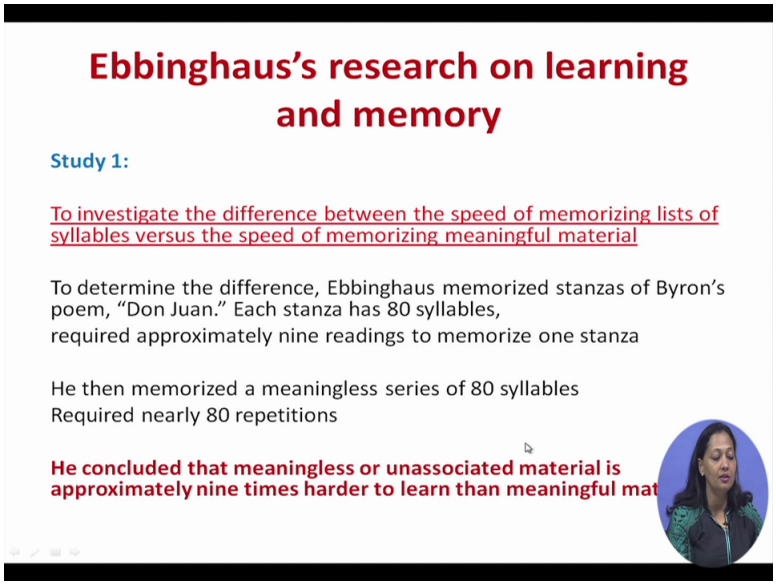
So to Ebbinghaus it was not the individual syllables that were designed to be meaningless, but rather that the entire list of stimulus words would be meaningless, so one would not be able to construe meaning from that, so deliberately they were constructed to be free of prior connections or associations as we just mentioned.

(Refer Slide Time: 24:42)



So Ebbinghaus's designed several studies using his meaningless series of syllables to determine the influence of various experimental conditions on human learning and retention, so let us just study discuss two of his studies.

(Refer Slide Time: 24:59)



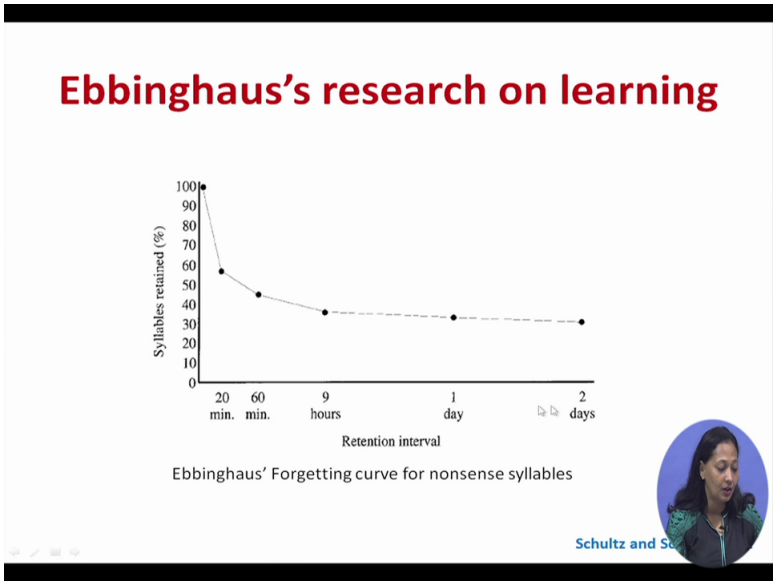
First one is to investigate the difference between the speed of memorising, memorising lists of syllables versus the speed of memorising meaningful material. So what was he trying to do here? He was giving list of so between the speed of memorising the list of syllables so this is a meaningless ones and as compared to a meaningful one. So how long would it take one to remember the meaningful material as well as the nonsense material? So would it take the same amount of time? What Ebbinghaus did was he use Don Juan Byrons Don Juan and he is saw that each stands had 80 syllables, so he saw that it required approximately 9 readings to memorise ones stand up.

On the other hand he then memorised so controlled the material by introducing 80 syllables of meaningless material ok so meaningless series of syllables and then he saw and then he learned it and he saw that it required 80 repetitions, so to learn the Don Juan which is meaningful material of the same amount of syllables so that is 80 syllables it took him 80 readings and here the eighty meaningless syllables meaningless series of 80 syllables required 80 repetitions, so he concluded that meaningless or unassociated material is approximately 9 times harder to learn than meaningful material, so that is very obvious to us even today in our daily life. How do we use it, see nobody studied it may be obvious but nobody studied this before Ebbinghaus.

The thing is that when we are trying and when we are trying to learn something, we generally remember it through associations. So we use either an acronym or we try and associate with on a different this part of the page, this material is written that is how we are trying to

remember it or say I learned it when this teacher used this example and that help to learn it better. So we are always trying to associated with something so meaningful material is easier to remember when we are trying and using more associations. So and meaningless material is obviously hard, so in another way if we find meaning in what we are learning we will remember it better.

(Refer Slide Time: 27:42)



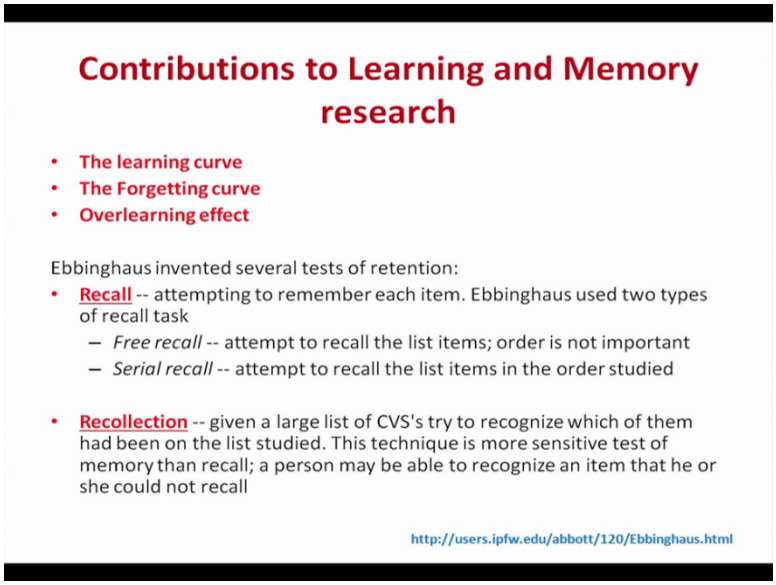
Now Ebbinghaus then showed the Forgetting curve ok we will discuss on this a little later and to study the effects the second study that he did was to study the effect of the length of the material to be learned on the number of repetitions necessary for a perfect reproduction, so how much of material so that you know the how much of material you are learning is actually going to effect the number of times you will require to repeat it. So he found that a longer material requires more repetitions and more time to learn.

Now he occasionally what he did he actually see at that point of time he manipulated the independent variable. He changed that is he changed the number of syllables, he increased the number of syllables to be learned and he saw that the average time to memorise a syllable increase. So if you make the task longer then it takes more time to learn it and you know this is of course predictable in our daily life, we all know that the more we have to learn the longer it takes us to learn. Nobody as I mentioned earlier also nobody showed it through experimentation and he experimentally verified it.

The other thing that you know these days you will many of you students who are conducting experiments on memory will know that one of the experiments we try and do in the

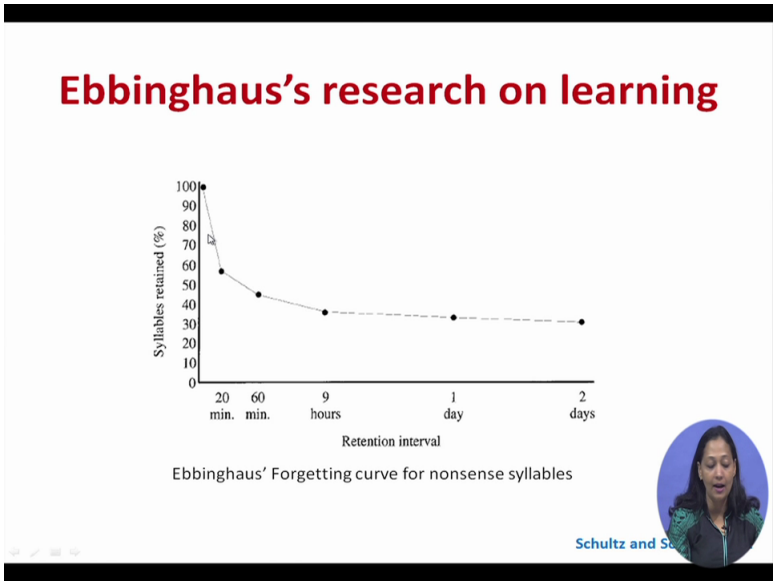
preliminary classes of psychology is whole versus part learning where we try and either we compare whether whole learning is better or part learning is better where you the length of the material is when say if you are trying to learn 12 syllables at a time, how long is it taking how many repetitions or how many trials is it taking you to learn that and then on the other hand when you are using smaller list say half the material then how long is it taking you to learn it. So several times this is a common very common experiment that we conduct in our preliminary classes and foundation classes in psychology.

(Refer Slide Time: 30:16)



So it is this is one of the experiments that Ebbinghaus did way back in the 1890s and so what is Ebbinghauss contribution to learning and memory research Ebbinghaus spoke about the learning curve as in with his he showed it through represent graphical representation how with the increase in each trial the number of syllables is increased, the learning increases. So then he spoke about the Forgetting curve and of the Over learning effect, so he spoke I will just come to the Forgetting curve.

(Refer Slide Time: 30:47)



So basically he said that if you learn a material and then you do not rehearse that material, so you do not repeat it or rehearse that practice that material then over time it will gradually get lost a certain amount of it. A large amount of it will get lost in the next 20 minutes then within an hour as you can see over hours and days a lot of material will be lost. So he showed that you know this showed the importance of how much the rehearsal and this also showed that a certain amount of information can be recalled or can be retained after learning and most of it is lost.

He also spoke about the Over learning effect, Over learning effect indicates that there is say there is an optimum number of times that you need to repeat to learn a list completely, so you are trying to learn a poem so you need perhaps 8 trials or 8 repetitions to learn it completely, but as the Forgetting curve shows a lot of it will be Forgotten very soon within the next 20 minutes and then within an hour.

So over learning indicates after that how much time are you spending on further learning the list, so Ebbinghaus says that the more you over learn so after that optimum number of trials if you learn it more the number of times that you used to learn it more the longer the time your that information will be retained. So students can definitely see an implication of this in your regular work say if you are just learning it the day before the exam you have learned it to the optimum for you to remember it till the end of the exam paper.

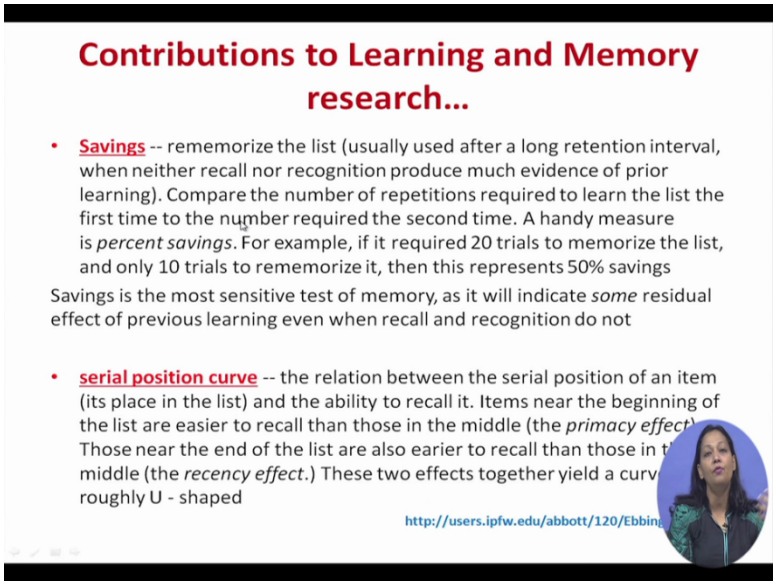
So you will see that you will not be able to recall it after a couple of days. On the other hand, if there is material that you have learned as we say thoroughly for where you have over

learned so you have gone beyond that optimum number of times then you recall it better even days after the examination is over, so then Ebbinghaus invented several tests of retention and we already spoke about the recall where he used two types of recall tasks. So one is the free recall and the other is the serial recall, so the free recall is you remember say material from a list of syllables you remember it randomly.

So maybe you know as you can recall it, so maybe you recall the first syllable first then the last one and then maybe second and last but one so that way it is random, the order is not important. Serial recall is an attempt to recall the list of items in a serial order as it was presented. Now as you can understand you know serial recall would be tougher than free recall because even if you try it out ty out creating a nonsense syllables list and try out try to lean the material, you will see that you will remember the last ones better as compared to the and the first ones name but not the middle ones. So this is of course takes us to the primacy and the recency effect. Primacy effect would be the first ones that you learned are remembered because they were learned without any interruptions or interference of other similar material.

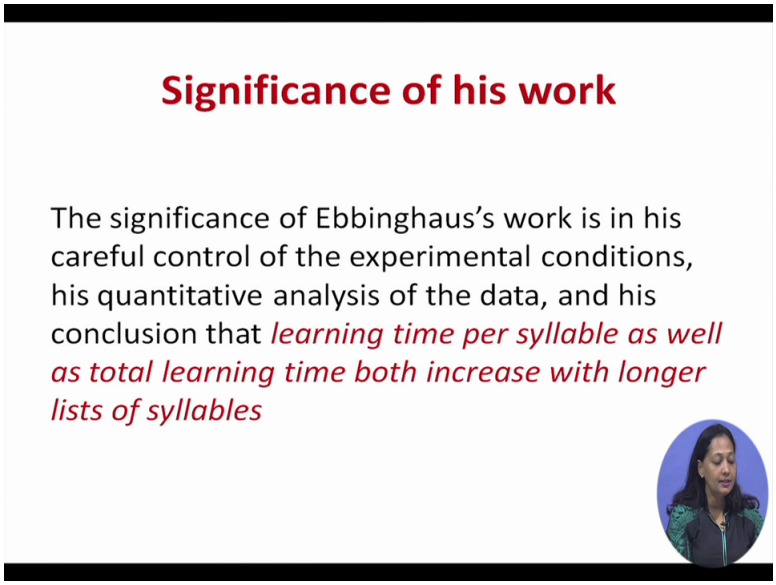
The last ones are remembered is as the last thing that you have heard, so it is that is the recency effect, so this is recall so definitely if you are trying to remember it in serial order then it is tougher because even though your last syllables may be may be you know in your in the tip of your tongue, but you will have to try and recall it in order. So then he spoke about recollection and he showed that this technique is a more sensitive test of memory than recall. So a person may be able to recognise an item, but he or she may not be able to recall, so there so recollection or recognition would be another way of getting information from retrieval so a retrieving information from storage.

(Refer Slide Time: 35:38)



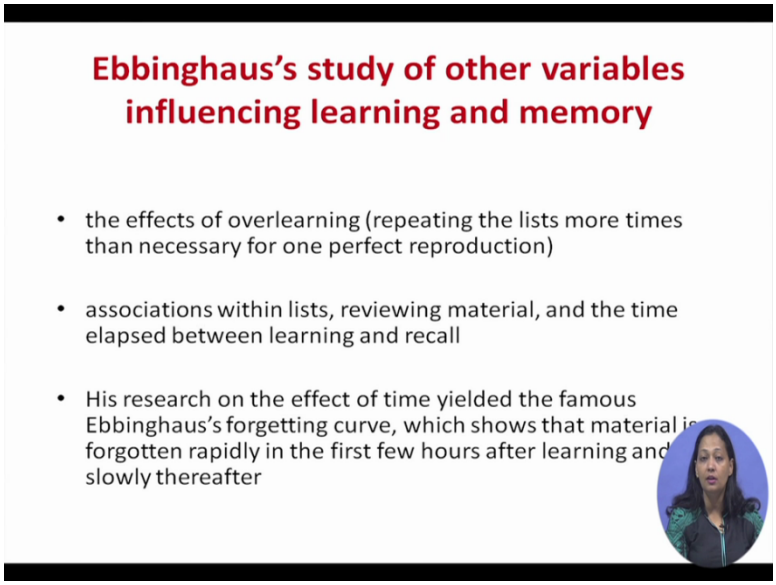
So these are and of course he spoke about Savings so to he says that if you are trying to rememorize a list that is learned earlier that would take way lesser time as compared to something that you learned earlier learning for the first time that is why we say that revision is very important. If you had a vision earlier then a revision will help you to remember things better, so it will also take less time when you see it for the second time so to learn it, it will take less time to learn it. And serial position curve, so he said that it is important as I mentioned of the serial position basically talks about the primacy and the recency effects that I just mentioned.

(Refer Slide Time: 36:27)



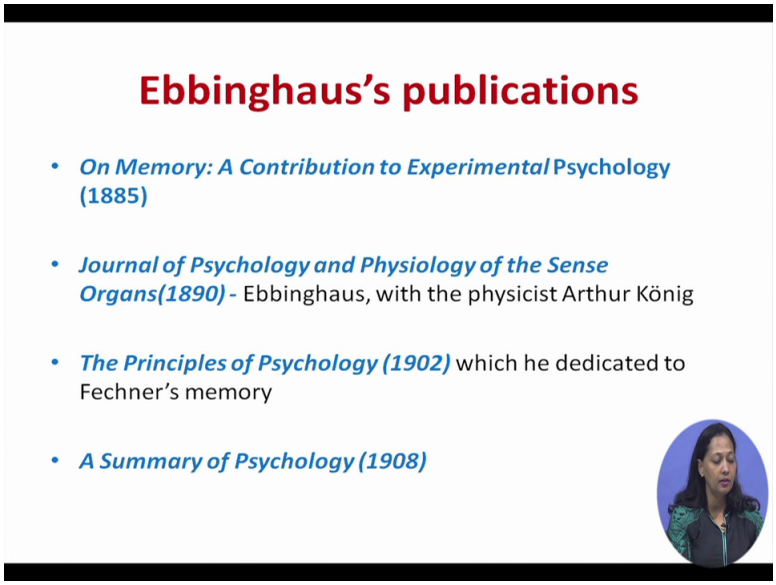
So what is the significance of Ebbinghaus's work, Ebbinghaus's work is as the significance is in his careful control of the experimental conditions his quantitative analysis of the data and his conclusion that learning time per syllable as well as total time learning time both increases with longer list of syllables, so this is something that he had done way back so many years ago.

(Refer Slide Time: 36:55)



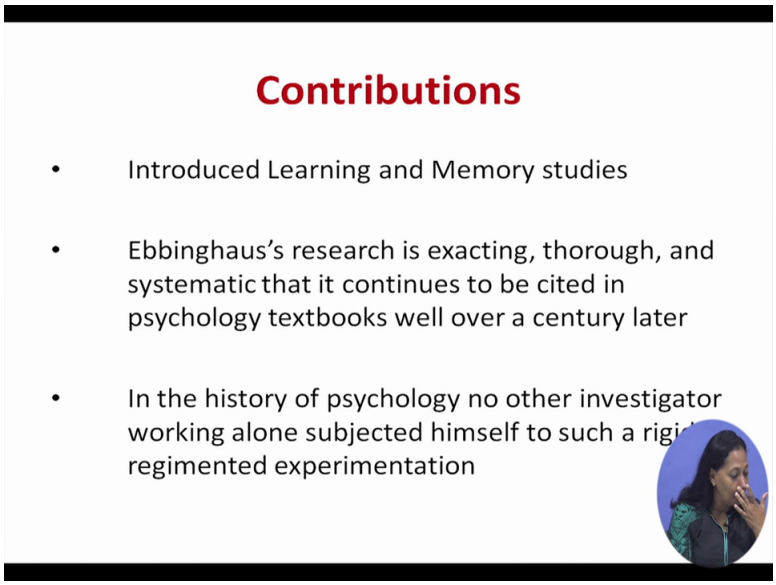
And he also showed that the he also studied other variables influencing, learning and memory and he showed the effects of over learning, he showed the association within the lists reviewing material and the time elapsed between learning and recall and his research was also on the effect of time yielded by the famous Ebbinghaus Forgetting curve, so we have discussed that too so these are you know the impacts of his study. These researches have led to several studies later on, so you will come across the dual model of memory, the levels of processing model of memory and then working memory and there have been several other memory studies that have started with primarily with Ebbinghaus's research.

(Refer Slide Time: 37:44)



So these are some of Ebbinghaus's publications so On Memory Contributions to Experimental psychology, see he wrote this in 1885 and Journal of Psychology and Physiology of Sense Organs, so this was in 1890 which he wrote with the another physicist Arthur Konig and The Principles of Psychology in 1902 and A Summary of Psychology in 1908. So he was not a part of any university, he did not start a journal or he did not have any relationship with any laboratory setting but his contributions are immense in the field of psychology, experimental psychology and cognitive psychology.

(Refer Slide Time: 38:15)



So he introduced learning and memory studies, his research was exacting thorough and systematic and we still study it and we still use nonsense syllables and in the history of

psychology no other investigator working alone subjected himself to such a rigid regimented experimentation. I think that is about it today, Thank you.